ALBERTA CHAPTER OF THE WILDLIFE SOCIETY

Recommendations for the Coal Consultation Committee

September 1, 2021

The Alberta Chapter of The Wildlife Society (ACTWS) is pleased to provide these recommendations to the Coal Consultation Committee. The ACTWS is a non-profit organization representing over 425 wildlife professionals in the province of Alberta. Our mission is to inspire and empower wildlife professionals to engage in science-based management and conservation of wild animals and their habitats. Our dedication to that outcome is reflected in our thoughtful, innovative work. We are affiliated with The Wildlife Society, the largest organization of wildlife professionals in the world. Each of our members loves Alberta for the diversity of economic, wilderness, and wildlife opportunities it provides. In July 2021, we delivered a presentation to the coal consultation committee outlining our recommendations pertaining to coal development in Alberta. This follow-up document details our comments and provides further information. Our submission to the Coal Consultation Committee also includes:

- Two recordings of our Coal Mining webinar series. Part 1 focused on cumulative effects and included presentations by Dr. Brad Stelfox; Part 2 focused on reclamation and included presentations by Stella Swanson, Beth MacCallum, and Eckehart Marenholtz.
- A copy of the PowerPoint slides from our presentation in July.
- A copy of the ALCES report: *Cumulative Effects of Land Uses and Conservation Priorities in Alberta's Southern East Slope Watersheds*.

We understand that the Coal Consultation Committee is facing large volumes of work to consider throughout this process and that fully digesting that material is a challenge unto itself. In this vein, we are able to meet with the Committee at any time to discuss any of our recommendations in more detail.

Overall Recommendations

1. New permits for coal mining exploration or development in Alberta should not be granted where these activities will endanger species at risk, either provincially or federally listed, and their habitats.
2. Regarding existing coal mines and any potential proposals that do not pertain to the above recommendation:
    a. Robust cumulative effects assessments should be required for any assessments associated with changes to mine operations or exploration activities.
    b. Reclamation certificates should be based on site specific attributes and demonstrate success in achieving biodiversity goals, including wildlife and their habitats. Reclamation plans and measures of success should be based on scientific evidence. Mitigation

measures should be monitored for effectiveness over the long term, possibly decades depending on the site.

3. Any new coal policy should integrate and fit within the context of previously approved land use planning processes, including the Land Use Framework and associated Regional Plans, sub-regional plans (e.g., the Porcupine-Livingstone Recreation Management Plan), and any watershed plans from Watershed Advisory and Planning Councils (e.g., the Oldman Watershed Council).
4. All development proposals, whether coal or otherwise, need to incorporate robust climate change modeling in decision making.

The following information provides the background and justification for our overall recommendations. In some instances, more detailed recommendations are provided.

Cumulative Effects

ALCES assessment

One of the ACTWS' primary concerns with new and expanding coal mining developments along Alberta's eastern slopes are associated with cumulative effects. In 2020, we commissioned ALCES to conduct a cumulative effects assessment of the Bow and Oldman Watersheds (ALCES, 2020). The full report was a big part of our presentation to the coal consultation committee and is included in this package. Below is a summary of the key findings.

The key concept of cumulative effects is that small individual impacts can combine spatially and temporally to cause large changes to the environment. This is critical for the eastern slopes where multiple activities are already occurring, and already leading to various cumulative effects. Cumulative effect assessments (CEAs) examine landscape scale processes and impacts, and as such, are conducted at the regional scale. Conversely, Environmental Impact Assessments (EIAs) conducted by proponents often focus on a particular development's footprint and impacts. While this information is useful, it neglects to consider impacts at meaningful spatial and temporal scales, thus EIAs are frequently inadequate to fully describe the potential impacts of a development.

The purposes of the CEA commissioned by ACTWS were to test and provide predictions associated with the landscape level impacts of: 1) the status quo of land use management, and 2) other possible development and protection scenarios. This assessment modelled the impacts of all existing land uses: forestry, oil and gas extraction, roads, trails, agriculture, and settlements, as well as the Grassy Mountain coal mine. No other proposed coal mines were included as the 1976 Coal Policy was still in place when the CEA was completed and other mine proposals had not yet come forward with sufficient detail to be included in the models. The CEA assessed the cumulative effects of multiple land uses and climate change to threatened species of trout (Westslope Cutthroat trout and Bull trout) in the Southern East Slopes. Trout were selected as a surrogate for biodiversity, as an indicator for many other species, and were considered representative of various landscape values facing multiple threats. We used a Fish Sustainability Index (FSI) as a measure of risk to fish sustainability over time; the FSI ranges from 0 (functionally extirpated, high risk) to 5 (completely sustainable, no risk).

With their diversity of land uses, ecological, and economic significance, we wanted to prioritize which parts of the eastern slopes may be best suited for conservation programs. Not all watersheds are equal in terms of their ecological significance or sensitivity, so we ranked them according to conservation effectiveness (FSI gains). This measure also included economic projections, which we defined as the conservation cost (loss to the provincial GDP with reduction in natural resource extraction in an area). The overall prioritization was based on:

$$\text{Conservation cost-effectiveness} = \frac{\text{Effectiveness (FSI Gain)}}{\text{Cost (GDP loss)}}$$

We calculated cost-effectiveness for each trout species individually and then averaged across the two species to calculate overall conservation cost effectiveness. With this calculation, we could identify priority watersheds that have the greatest conservation gains with the lowest cost to the provincial GDP.

In the Business As Usual scenario, the FSI for both Westslope Cutthroat and Bull trout were low and declining over time. These results demonstrate that both trout species are already at risk of extirpation in several watersheds in the study area. The greatest risks to trout population sustainability are angling mortality, fragmentation, climate change, and, in the case of Westslope Cutthroat Trout, competition from hybrid trout.

Under the Protection Scenario, trout populations responded quite well with moderate increases in conservation efforts. If 50% of the watersheds (up from the current 30%) are protected, meaning they prioritize ecological processes and trout sustainability, then many watersheds display moderate risks to trout populations over the next 50 years despite climate change. Risk to Bull trout dropped from very high to moderate in three watersheds and from very high to high in 18 watersheds. Risk to Westslope Cutthroat trout dropped from high to low in two watersheds, from very high to moderate in four watersheds, and from very high to high in seven watersheds. These results demonstrate the importance and effectiveness of prioritizing particular watersheds for trout protection.

Overall, the watersheds with the highest conservation cost-effectiveness were found in the western portion of the eastern slopes. This is because they have fewer natural limitations for trout and provide more suitable habitat, less permanent footprints (e.g., agricultural lands or settlements), and climate change impacts are reduced due to the higher elevation. Therefore, protecting these headwater areas from future footprint and reclaiming temporary footprint have the greatest potential to increase trout population viability and enhance ecological integrity overall.

Other cumulative effects assessments

Part of the challenge with any kind of industrial development along Alberta's eastern slopes is that cumulative effects assessments are often inadequate, incomplete, and improperly conducted. This is partially because the onus to conduct CEAs falls to the proponent. Yet, it is often in the proponent's best interests to focus their EIA on their own industrial footprint. As a result, more comprehensive and robust CEAs are often conducted by non-profit organizations with limited funds. One of the speakers in

our Coal Mining: Cumulative Effects webinar[1], Dr. David Post, presented the results of a 5-year long, $62 million project funded and prioritized by the Australian government. As a result of this comprehensive effort, the research presented an array of recommendations for coal mining management and monitoring that were adopted by industry to improve practices in Australia. The Alberta Government has not funded any equivalent analysis along the eastern slopes, yet this landscape is impacted by multiple human uses and is in dire need of a thorough CEA to inform land use planning and management.

CEAs should be able to withstand scrutiny by biologists, landscape ecologists, and planners. When reviewing the CEA for the Grassy Mountain proposed mine, we found several areas of concern that rendered questionable results that were not scientifically defensible:

1. The temporal time frame of the CEA was inadequate. CEAs should consider the long-term effects of the project on wildlife, air quality, and even access to recreational opportunities beyond three years post-mine operations. CEAs should model impacts at least 50 years into the future and ideally be based on a variety of future scenarios.
2. A CEA should model additive effects of land uses in the study area effectively. A CEA is not an either-or scenario when one land use is compared to another (e.g., the impacts of mining versus the impacts of forestry).
3. Recreational impacts need to be considered in addition to industrial impacts. Industrial proponents often include industrial footprints, but recreational activity on the eastern slopes is an increasing form of human use that affects wildlife and their habitats in unique ways.
4. Linear disturbance density, including trails, routes, and roads, need to be included in any CEA. These linear features can be used as a surrogate for human use in the eastern slopes and are frequently underestimated in CEAs.

Habitat Loss and Fragmentation

Many species are affected when large patches of habitat are removed from the landscape, particularly with large-scale industrial activity. The practice of coal mining involves removing a large section of forest, digging the coal out beneath it, and then attempting to replace that habitat. There is direct impact to wildlife movement and habitat use through habitat alteration, as well as indirect impacts associated with increased road traffic, and noise and light pollution.

Indirect impacts are associated with a species Zone of Influence (ZOI). Gibeau (1998) described ZOI as the distance measured horizontally where grizzly bears could be affected by human activity; this ZOI in Banff and Yoho National Parks for linear non-motorized features (i.e., trails) was 400 m. Kite et al. (2016) refined this estimate for ZOI as it pertained to roads and found it varied by season, age, and sex ranging from 25 m for subadult female grizzly bears in the non-breeding season to 90 m in the breeding season; male grizzly bears displayed a more consistent response to roads and had a ZOI around 70 m. ZOI should be included in CEAs, but rarely are. Other species will have different ZOIs, also known as flushing

[1] A link to the webinar recording is included in our submission, but a summary and speaker bios can also be found on our website: https://www.actws.ca/event/webinar-coal-mining-part-1-impacts-and-cumulative-effects/

distances or escape response distances. Ungulates have been found to pay attention to the behaviour of people approaching them and may perceive greater risk when disturbed in open habitats. Female ungulates or groups with offspring have greater flight responses than adult groups (Stankowich, 2008). Stankowich (2008) also found, however, that humans on foot were more disruptive than vehicles or noises. The differences between grizzly bears and ungulates demonstrates the complexity of wildlife response to industrial activity and operations, therefore CEAs should include discussion regarding ZOI for multiple species groups.

The generation time of the affected species is shorter (on average less than 20 years) than most mines' operational period and reclamation phase. This can be problematic for large carnivores, like grizzly bears, specifically. The learning process of mother to young is important for carnivores to understand habitat availability in their home ranges (Nielsen et al. 2013) and how to coexist with human land uses (Morehouse et al. 2016). Individuals that are left after the mine has closed and been reclaimed might not see the mine as habitat, thus it could take several years for them to consider the reclaimed mine as available habitat. This lag time is not considered in EIAs or CEAs. This is particularly concerning for species at risk that already have declining or low-density populations (e.g., olive-sided flycatcher, grizzly bears, trout). If the populations are already low and any mortality or habitat displacement is significant, it is erroneous to assume that these species will repopulate a rehabilitated landscape 30 years from now when some may run the risk of extirpation by then.

Linear Disturbance Density

Habitat fragmentation along the eastern slopes is characterized largely by linear disturbance. These are the roads, trails, cutlines, and other linear features that fragment intact habitat patches. While the impact of linear disturbance can depend on size (i.e., width and length), traffic volume, and human activity types, all linear disturbances have the potential to alter wildlife habitat use and movement patterns. Of the total human footprint, the cumulative direct and indirect effects of roads and the access they enable are among the most pressing threats to conservation of wildlife (van der Marel et al., 2020). Mining activity creates and expands linear footprint through mine access roads for operations and exploratory roads. Exploratory roads are particularly problematic because there are usually many of them created in a high density, thus they have a disproportionate effect on habitat fragmentation. For example, Bull trout occurrence sharply declines with increasing road density until ~0.7 km/km^2, and reaches zero at ~1.6 km/km^2 (Ripley et al., 2005). In addition, exploratory roads are especially problematic because the current regulatory process does not require mining proponents to conduct an EIA or CEA for the exploration phase. This is counter to the reality that exploration has a significant impact on the landscape.

Most research focused on the impacts of human use on grizzly bear habitat use in Alberta have been directed at industrial landscapes on public lands (Graham et al., 2010; Ament et al., 2008). Roads create human access into grizzly bear habitat (Nielsen et al., 2005, Schwartz et al., 2006); grizzly bear survival is related to road density (Boulanger et al., 2013), with subadult bears being most vulnerable to road-based mortality (Boulanger and Stenhouse, 2014). Most human-caused grizzly bear mortalities in Alberta and British Columbia are less than 500 m from a road (Benn and Herrero, 2002; Boulanger and

Stenhouse, 2014; McLellan, 2015), or within 200 m of a trail (Benn and Herrero, 2002). These distances apply to both protected areas where firearms are prohibited and public lands where poaching is a risk.

Linear disturbance, and the motorized access it creates, affects grizzly bears at the individual and population levels through altering their habitat use, home range selection, movements, population fragmentation, survival, and reproductive rates that ultimately are reflected in population density, trend, and conservation status. While high road densities and motorized recreation have been demonstrated to negatively impact grizzly bear habitat use (Ladle et al., 2018), these impacts may be lessened in protected areas where motorized recreation is not permitted, and fewer roads exist. Male and female grizzly bears have been found to avoid trails with a high probability of motorized activity, as well as display increased movement rates in response to motorized recreation. Bear habitat selection increases when in proximity to non-motorized trails (Proctor et al., 2019).

Overall management recommendations for grizzly bears are clear. There should be few or no roads within 500 m of habitats containing late summer and autumn food resources for grizzly bears (e.g., major berry fields, white bark pine stands). In areas with moderate habitat quality close to human settlements, road densities near 0.6 km/km^2 with more than 60% secure habitat (i.e., >500m from an open road) are meaningful thresholds that may allow female grizzly bears to have sustainable survival rates. These thresholds are already frequently violated along the eastern slopes, the addition of coal mining exploratory roads and operational footprints will further exacerbate this existing problem. For example, the Livingstone-Porcupine area, which contains the location of the proposed Grassy Mountain mine, contains a linear disturbance of 2.4 km/km^2; at the watershed scale the density of linear disturbance ranges from 0.9 km/km^2 to 5.98 km/km^2 (Farr et al., 2018).

Linear disturbances are not all the same. A single track non-motorized trail does not create the same intensity of human impact as a double-lane paved road. It is important, however, that all linear disturbances are considered when examining cumulative effects on the landscape. One way to distinguish between the impacts of trails and roads can be their physical features (e.g., width, length, topography), but linear features should also be described based on traffic volume. For example, grizzly bears have been found to select habitat closer to roads in some areas, but also display increased movement across roads during the night when traffic volumes are lowest. This research also showed that bears selected areas further from high and medium traffic volume roads (Northrup et al., 2012). Incorporating traffic volumes of trails and roads can be an important variable in understanding the potential impact of linear features on wildlife movement and habitat use. That data is often not available for many recreational trails and roads along the eastern slopes; there is a need to gather more and better human use data to improve landscape modeling regarding the impacts of linear disturbance. These more scientifically robust models can then inform evidence-based decision making.

Regional Planning

According to the Coal Consultation Committee Terms of Reference, the committee is only responsible for answering issues that fall under the purview of the Minister of Energy and is not permitted to invite expert witnesses to the consultation. These conditions limit the committee, ignore the reality that coal

mining is a land use among many others, and essentially prevent the committee from conducting a holistic and thorough consultation. These restrictions affect the committee's ability to adequately consider previous government-led land use planning consultation processes.

The Alberta Land Use Framework (LUF) sets out an approach to manage public and private lands and natural resources to achieve long-term economic, environmental, and social goals. The purpose of the LUF is to sustain Alberta's growing economy in balance with Alberta's social and environmental goals (Government of Alberta, 2008). The LUF identified several strategies to plan for smart growth that were in alignment with multiple landscape level objectives. One strategy was to create a series of Regional Plans based on the larger provincial watersheds, and another was to use cumulative effects management at the regional level to manage impacts of development on land, water, and air. Although the eastern slopes fall within three regions, only the South Saskatchewan Regional Plan (SSRP) has been completed.

The SSRP is a legislated document guiding all development in the region (Government of Alberta, 2018). The SSRP commits the Government to reviewing the 1976 Coal Policy to confirm whether the land categories defined within it are still applicable to the landscape, with the eventual intention for the SSRP and subsequent sub-regional plans to supersede the coal categories to define where coal exploration can and can not occur in the region. The SSRP relies on the outcomes of sub-regional plans to identify areas appropriate for coal development, but none of these sub-regional plans have been completed or approved. In addition, as more CEAs are completed and sub-regional plans are drafted in consultation with stakeholders, it is becoming more apparent that the eastern slopes are already a very busy landscape facing many different demands. There may not be physical room for coal mining operations in a landscape that faces already high levels of human use.

The LUF, the SSRP, and the sub-regional plans underway, as well as the Policy for Resource Management of the Eastern Slopes (Government of Alberta, 1984) have all been the subject of comprehensive public consultation and Indigenous engagement. Throughout these consultations, the importance of the eastern slopes for water quality and quantity has been repeated by scientists, ranchers, recreationists, and Albertans downstream. As a result, all these policies and plans repeatedly prioritize protection of headwaters along the eastern slopes. It is imperative that the coal consultation committee consider the millions of Albertans that have already shared their perspectives through these other public consultation processes. Their views are no less valid today than they were in 1976 when the Coal Policy was created, or in 1984 when the Eastern Slopes Policy was revised, or in 2008 when the LUF was passed in the legislature. Until there is sufficient and effective consultation where coal mining is considered as a land use like any other, there should not be any changes to the 1976 Coal Policy and the categories it defines.

Reclamation

All proposed coal mines and their associated expansions are required to describe a reclamation plan, but more emphasis needs to be placed on the robustness and long-term effectiveness of these plans. Reclamation is just as much a part of the process as exploration and operations. It is highly unlikely that

any reclamation activity can accurately replace the habitat that is lost with mining. One of the most critical aspects of reclamation, therefore, is to clearly define the end land use and what constitutes success. Defining what kind of ecosystem will be constructed post-operations should be an important component of decision making. This should include wildlife and biodiversity measures and monitoring data describing how wildlife use different parts of the mine site (e.g., north vs south slopes, hydrological features). Reclamation plans also need to identify critical hydrological features and model various hydrological scenarios to guide planning.

Most mining operations practice progressive reclamation whereby disturbed areas are re-established once they are no longer required for ongoing operations. This is good standard practice, but is not a measure of reclamation effectiveness. Our second webinar in our coal mining series shared some of the latest challenges and successes regarding reclamation[2]. Reclamation activities can create habitats (e.g., retaining high walls can provide nesting platforms) and success with tree planting has been observed over 10+ years. These successes may take well over a decade to be observed, demonstrating the need for multi-decadal monitoring prior to issuing reclamation certificates and allowing companies to cease monitoring programs.

Other land uses, such as recreation, can impact the success of reclamation efforts across the broader landscape. Therefore, an understanding of how reclamation activities address existing and future cumulative effects is required. This complexity of reclamation planning is not usually presented as part of a proponent's EIA. This reduces certainty that reclamation activities will effectively improve the ecological integrity of the landscape.

Some mine proposals include reclamation of legacy coal mines as part of the justification for new or expanding mine footprints. This additional reclamation is framed as an ecological benefit since lands are reclaimed that would not have been otherwise. Reclaiming legacy mines can be part of the progressive reclamation process if legacy mine sites are reclaimed prior to any other mining operations. If successful, reclaimed legacy mine sites may provide for wildlife connectivity and habitat during mine operations. There are substantial challenges with this approach, however, as legacy sites require substantial investment of time and funds so that they are sloped according to the surrounding landscape, covered with an appropriate topsoil (which may be difficult to locate), and planted with native vegetative cover. Monitoring the success of reclamation of legacy sites includes quantifying growth and proliferation of native vegetation, limiting the growth of invasive vegetation, and changes in wildlife habitat use and movement. This monitoring data can be used to inform progressive reclamation activities for other mining operations. While there are benefits to reclaiming these legacy mine sites, their reclamation is not a justification for new mining. A new mine will create an array of ecological impacts that outweigh any potential success of reclaiming a legacy mine site. Reclamation is a tool to restore ecological function to an area, whether a legacy mine or existing mining operation.

[2] A recording of this webinar is in our complete submission, but a link to a summary and speaker biographies is here: https://www.actws.ca/event/webinar-coal-mining-part-2-reclamation-successes-and-challenges/

Reclamation requirements for both exploratory and mining operations are not well defined. Regulations should require more site-specific details regarding monitoring approaches, wildlife habitat use and movement, and hydrological processes prior to any project approval. Reclamation should be a long-term commitment on behalf of the proponent and the Government monitoring team. The fact that there are still footprints from previously closed mines is demonstrative of the fact that more robust measures need to be in place that ensure the proponent will be responsible for the reclamation. Albertans should not be responsible for reclaiming these lands. No mining work should be approved without these details already defined.

Reclamation certification requirements for wildlife need to be improved. Each mine has its own ecological, social, and cultural impacts and reclamation certification needs to consider local landscape features and values. Each mine's reclamation should be evaluated on its own merit and not based on other reclamation efforts across Alberta. Current certification revolves around landscape, soil, and vegetation attributes; wildlife and ecosystem processes criteria should also be included. Ecosystem processes and wildlife monitoring should include inter- and intra-species competition and relationships, habitat availability, quality, and quantity; species composition and abundance; arrangement of target species across the landscape; and seasonal wildlife habitat use patterns. Wildlife is the component that ties many aspects of the ecosystem together. Robust wildlife assessments are required to demonstrate reclamation activities have been successful and that the newly created habitat is on track to achieve wildlife related goals. Wildlife surveys should assess presence/absence of species, and reproductive success. However, presence/absence is a simple measure that may not reflect whether animals are using the habitat. More thorough, field-based assessments are required to quantify if animals are reproducing, denning, or raising young in the area. These attributes reflect a higher functioning ecosystem throughout the year on both the mine site and the broader landscape. Monitoring should be conducted throughout the year to report on wildlife life- cycles and habitat use throughout the seasons. Results of reclamation monitoring should be compared to other data from monitoring on the surrounding landscape to ensure reclamation success.

Even if reclamation is deemed successful, it may not be successful over the long term. There are multiple examples of dams breaching, selenium contaminating tributary streams, and excessive erosion for mining activities increasing sedimentation in critical fish habitat. These problems are significant and there does not appear to be any technology or mitigations that can guarantee these events will not occur. This is particularly problematic when we consider the already sensitive landscape of the eastern slopes.

Climate Change

Climate change and the accompanying biodiversity crisis are the biggest global challenges that humanity is facing. The Intergovernmental Panel on Climate Change (IPCC) recently released its sixth assessment report, which provides the current physical understanding of the climate system and climate change. Results show that human influence has warmed the climate at a rate that is unprecedented in at least the last 2000 years; climate change is already affecting every inhabited region across the globe with human influence contributing to many observed changes in weather and climate extremes (IPCC, 2021).

For Canada, climate models show that extreme weather events, including flooding and wildfires, will increase in intensity and frequency. Temperature fluctuations, like heatwaves and cold spells, will also become more common. These events have already started happening. The IPCC modeling suggests, however, that strong and sustained reductions in greenhouse gas emissions can limit climate change impacts. Unless immediate, rapid, and large-scale reductions in greenhouse gas emissions occur, limiting global temperature increases to less than 2^{o}C will not be possible. The results of this report emphasize the need to consider carbon emissions in all of our land use planning. New or expanded coal mining activities will contribute increased emissions and are not appropriate in the face of climate change.

While coal development may increase greenhouse gas emissions associated with extraction, use, and exporting, coal mining along the eastern slopes will also impact ecosystem resiliency. With their varied topography, rapidly changing elevations, and provision of headwaters, the eastern slopes are a critical landscape for climate refugia. Climate change refugia are areas that remain relatively buffered from climate changes over time; physical, ecological, and socio-cultural resources can persist in these pockets of habitats. Climate refugia are characterized by the occurrence of relatively stable local climatic conditions that persist despite change at regional or global scales (e.g., deep lakes, wetlands, rock glaciers and talus slopes, valleys with inversions; Morelli et al., 2016). These areas are often predicted to change less, or slower in the face of climate change, and should be prioritized for protection to allow species more time to survive and adapt. Alberta's Eastern Slopes have been identified as priority areas for climate refugia (Stralberg et al., 2020). This demonstrates the importance of the eastern slopes in maintaining biodiversity despite the impacts of climate change, particularly for more cold-dependent species like native trout. This refugia potential is weakened with large scale industrial activity.

Conclusion

The precautionary principle has four central components: 1) taking preventative action in the face of uncertainty; 2) shifting the burden of proof to proponents of an activity; 3) exploring a wide range of alternatives to possible harmful actions; and 4) increasing public participation in decision making (Kriebel et al., 2001). Applying the precautionary principle to land use decision making along the eastern slopes is required for the several species at risk to continue to have access to habitat, as well as to ensure sufficient water quality and quantity for the millions of Albertans that rely on healthy headwater streams.

The ACTWS and its members are not against responsible development of Alberta's natural resources. Part of our role is to ensure, however, that these decisions are based on robust and credible scientific information. At this time, there is no scientific justification to expand or permit coal mining activities in important headwaters or habitats of species at risk.

References

ALCES. 2020. Cumulative effects of land uses and conservation priorities in Alberta's Southern East Slope watersheds. Calgary, Alberta. 86 pp. Available at: https://www.actws.ca/wp-content/uploads/Final-Report_May-8-2020.pdf

Ament, R., Clevenger, A. P., Yu, O., & Hardy, A. (2008). An assessment of road impacts on wildlife populations in U.S. National Parks. *Environmental Management, 42*, 480-496.

Benn, B., & Herrero, S. (2002). Grizzly bear mortality and human access in Banff and Yoho National Parks, 1971-98. *Ursus, 13*, 213-221.

Boulanger, J., & Stenhouse, G. (2014). The impact of roads on the demography of grizzly bears in Alberta. *PLoS One, 9(12)*: e115535. doi:10.1371/journal.pone.0115535.

Boulanger, J., Cattet, M., Nielsen, S. E., Stenhouse, G., & Cranston, J. (2013). Use of multi-state models to explore relationships between changes in body condition, habitat and survival of grizzly bears (*Ursus arctos horribilis*). *Wildlife Biology, 19*(3), 274-288.

Farr, D., Braid, A., Slater, S. 2018. Linear disturbances in the Livingstone-Porcupine Hills of Alberta: Review of potential ecological responses. Government of Alberta, Environment and Parks. ISBN No. ISBN 978-1-4601-4033-8.

Gibeau, M. L. 1998. Grizzly bear habitat effectiveness model for Banff, Yoho, and Kootenay National Parks, Canada. *Ursus, 10,* 235-241.

Government of Alberta. 1984. A Policy for Resource Management of the Eastern Slopes Revised 1984. Edmonton, AB. Accessed August 18, 2021 at: https://open.alberta.ca/dataset/63df0041-7619-4fc9-948b-738cf108e47c/resource/6938bfdd-1316-4f84-adf7-5ed1744b3d84/download/1984-policyresourcemanagementeasternslopes.pdf

Government of Alberta. 2008. Land-Use Framework. Edmonton, AB. 58pp. Accessed August 18, 2021 at: https://open.alberta.ca/dataset/30091176-f980-4f36-8f5a-87bc47890aa8/resource/bc4b3fac-5e59-473b-9a99-1a83970c28e7/download/4321768-2008-land-use-framework-2008-12.pdf

Government of Alberta. 2018. South Saskatchewan Regional Plan 2014-2024: Amended May 2018. Edmonton, AB. Accessed August 18, 2021 at: https://open.alberta.ca/dataset/460ac866-4416-4d77-a25a-a02fab85a6ec/resource/8261ce03-aa0f-4621-8e2d-c610a72ac37c/download/south-saskatchewan-regional-plan-2014-2024-february-2017.pdf

Graham, K., Boulanger, J., Duval, J., & Stenhouse, G.. (2010). Spatial and temporal use of roads by grizzly bears in West-Central Alberta. *Ursus, 21*(1), 43-56.

IPCC. (2021). Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S. L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M. I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T. K. Maycock, T. Waterfield, O. Yelekçi, R. Yu and B. Zhou (eds.)]. Cambridge University Press. In Press.

Kite, R., Nelson, T., Stenhouse, G., & Darimont, C. (2016). A movement-driven approach to quantifying grizzly bear (Ursus arctos) near-road movement patterns in west-central Alberta, Canada. *Biological Conservation, 195*, 24-32.

Kriebel, D., Tickner, J., Epstein, P., Lemons, J., Levins, R., et al. 2001. The precautionary principle in environmental science. *Environmental Health Perspectives*. doi.org/10.1289/ehp.01109871

Ladle, Andrew, Tal Avgar, Matthew Wheatley, Gordon B. Stenhouse, Scott E. Neilsen, and Mark S. Boyce. (2018). Grizzly Bear Response to Spatio-Temporal Variablity in Human Recreational Activity. *Journal of Applied Ecology*. *56,* 375-386.

McLellan, B. N. (2015). Some mechanisms underlying variation in vital rates of grizzly bears on a multiple use landscape. *The Journal of Wildlife Management, 79*(5), 749-765.

Morehouse A. T., T. A. Graves, N. Mikle, M.S. Boyce. (2016). Nature vs. Nurture: Evidence for Social Learning of Conflict Behaviour in Grizzly Bears. *PLoS ONE 11(11),* e0165425. doi:10.1371/journal.pone.0165425

Morelli, T.L., Daly, C., Dobrowski, S.Z., Dulen, D.M., Ebersole, J.L., Jackson, S.T., et al. (2016). Managing Climate Change Refugia for Climate Adaptation. *PLoS One,* doi.org/10.1371/journal.pone.0159909

Nielsen, S. E. (2005). *Habitat ecology, conservation, and projects population viability of grizzly bears (*Ursus arctos L.*) in West-Central Alberta, Canada*. (Unpublished doctoral dissertation). University of Alberta, Edmonton Alberta.

Nielsen, S., A. Shafer, M. S. Boyce, and G. B. Stenhouse. (2013). Does learning or instinct shape habitat selection? *PLoS ONE,* 8(1), e53721.

Northrup, J. M., J. Pitt, T. B. Muhly, G. B. Stenhouse, M. Musiani, and M. S. Boyce. (2012). Vehicle traffic shapes grizzly bear behaviour on a multiple-use landscape. *Journal of Applied Ecology,* 49, 1159–1167.

Proctor, Michael F., Bruce N. McLellan, Gordon B. Stenhouse, Garth Mowat, Clayton T. Lamb, and Mark S. Boyce. (2019). Effects of Roads and Motorized Human Access on Grizzly Bear Populations in British Columbia and Alberta, Canada. *Ursus, 30(2),* 16-39.

Ripley, T., G. Scrimgeour, and M.S. Boyce. (2005). Bull trout (*Salvelinus confluentus*) occurrence and abundance influence by cumulative industrial developments in a Canadian boreal forest watershed. *Canadian Journal of Fisheries and Aquatic Sciences,* 62, 2431-2442.

Schwartz, C. C., Haroldson, M. A., White, G. C., Harris, R. B., Cherry, S., Keating, K. A., . . . Servheen, C. (2006). Temporal, Spatial, and Environmental Influences on the Demographics of Grizzly Bears in the Greater Yellowstone Ecosystem. *Wildlife Monographs, 161*, 1-68.

Stankowich, T. (2008). Ungulate flight responses to human disturbance: A review and meta-analysis. *Biological Conservation, 141*, 2159-2173.

Stralberg, D., Carroll, C., and Nielsen, S. E. (2020). Toward a climate-informed North American protected areas network: Incorporating climate change refugia and corridors in conservation planning. *Conservation Letters, 13,4,* e12712.

Van der Marel, R. C., P. C. Holroyd, P. N. Duinker. (2020). Managing human footprint to achieve large-landscape conservation outcomes: Establishing density limits on motorized route-user networks in Alberta's Eastern Slopes. *Global Ecology and Conservation,* 22, e00901.